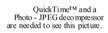
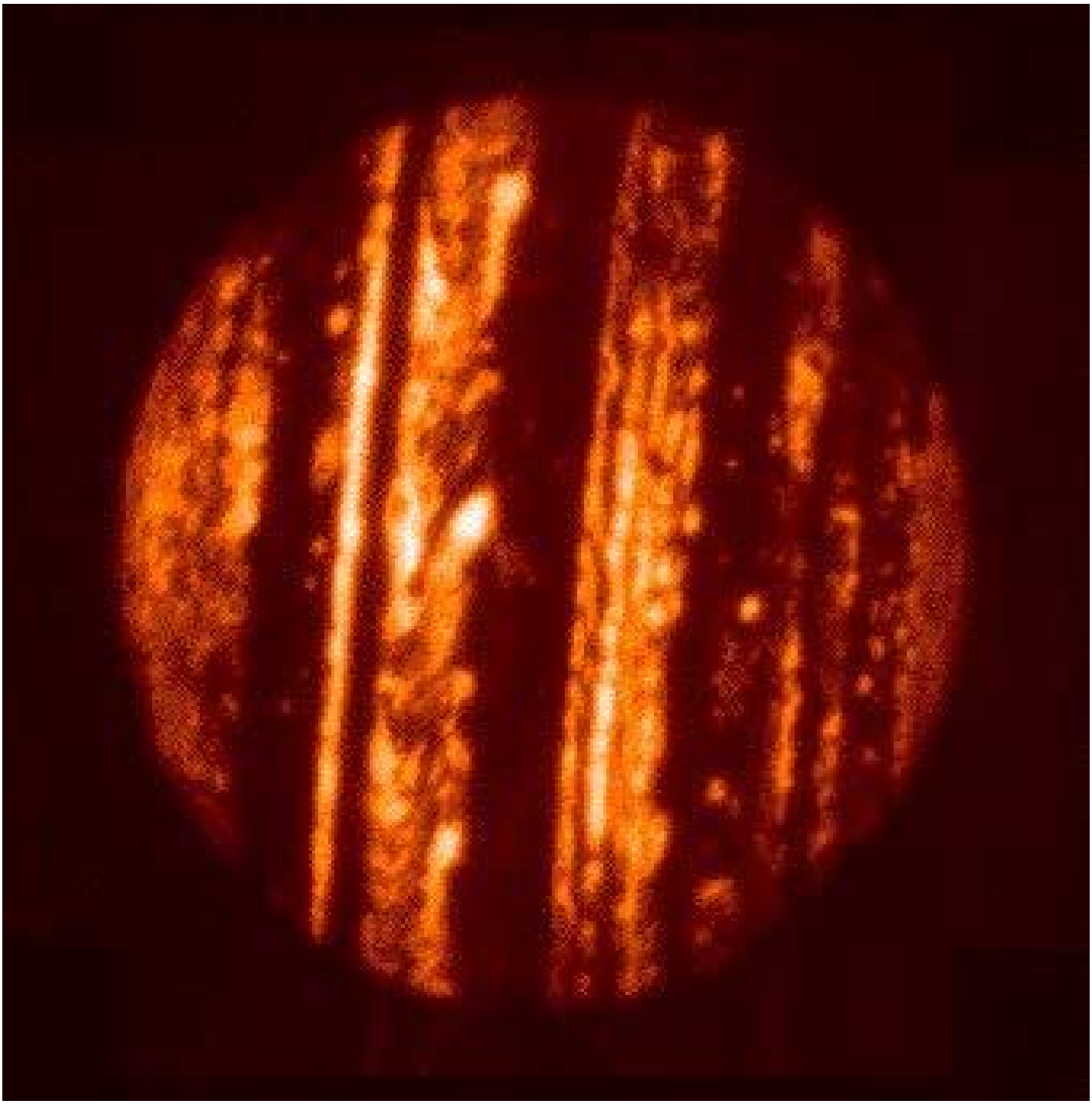
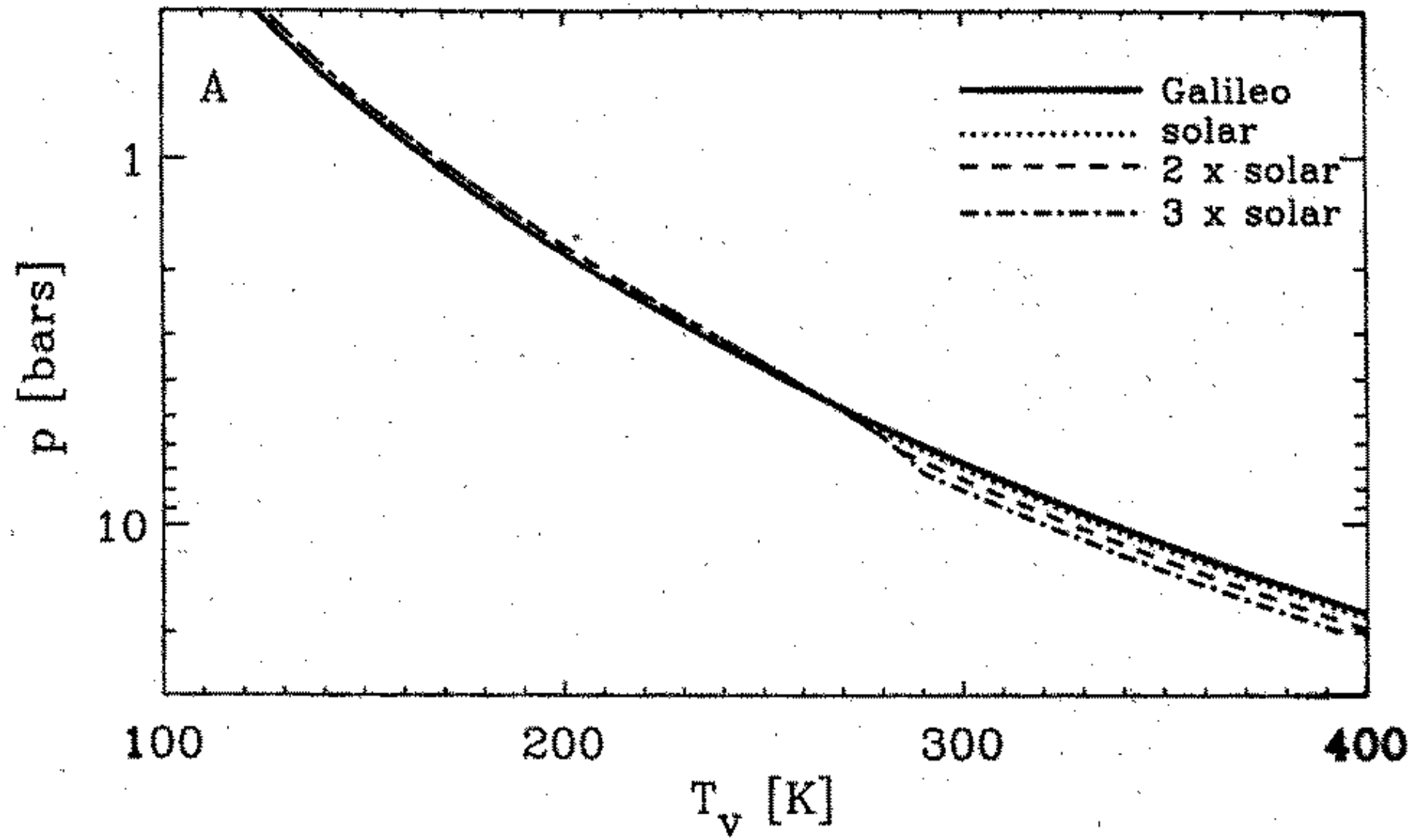
Science Rationale for Giant Planet Probes

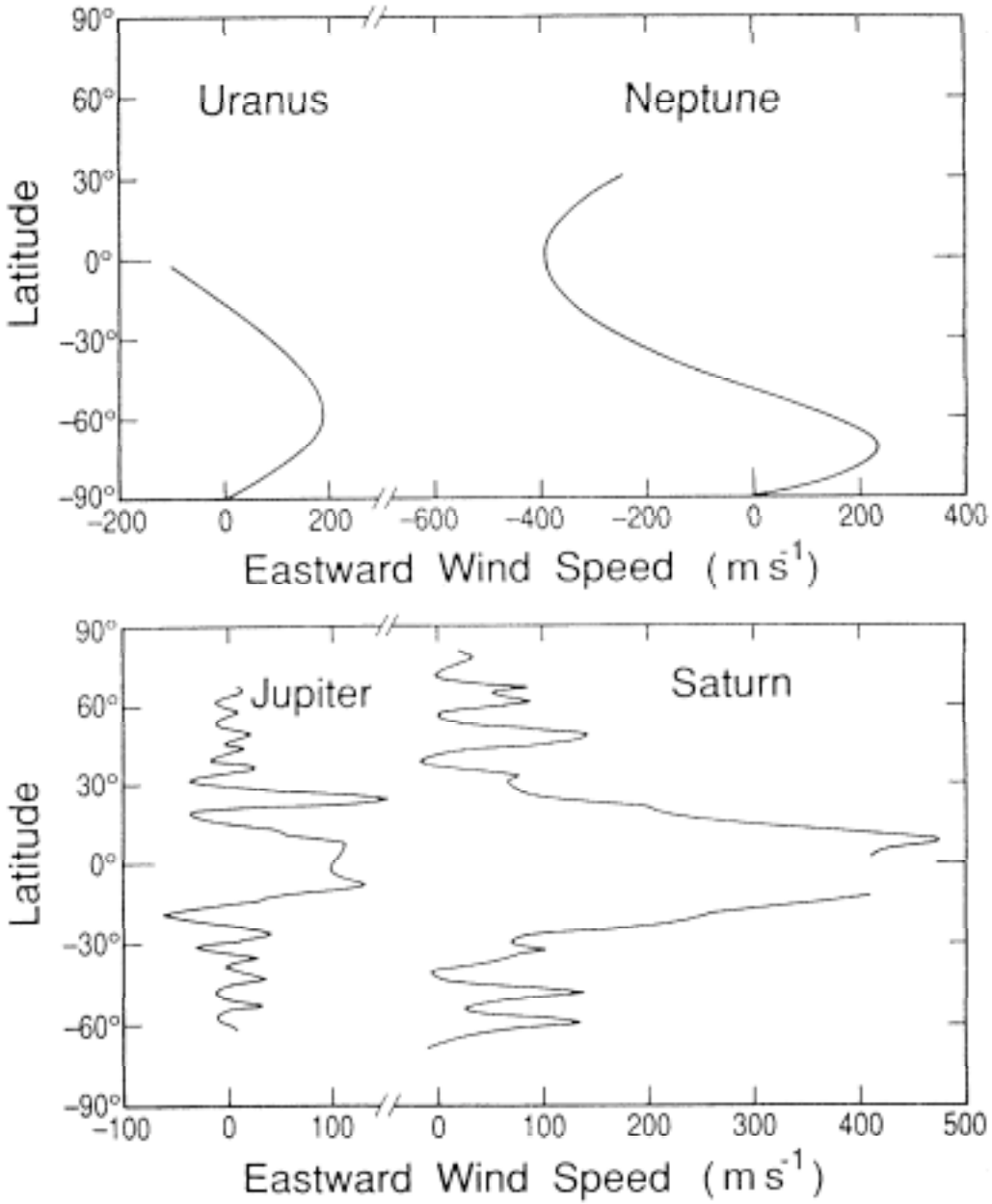
Andrew Ingersoll May 16, 2003

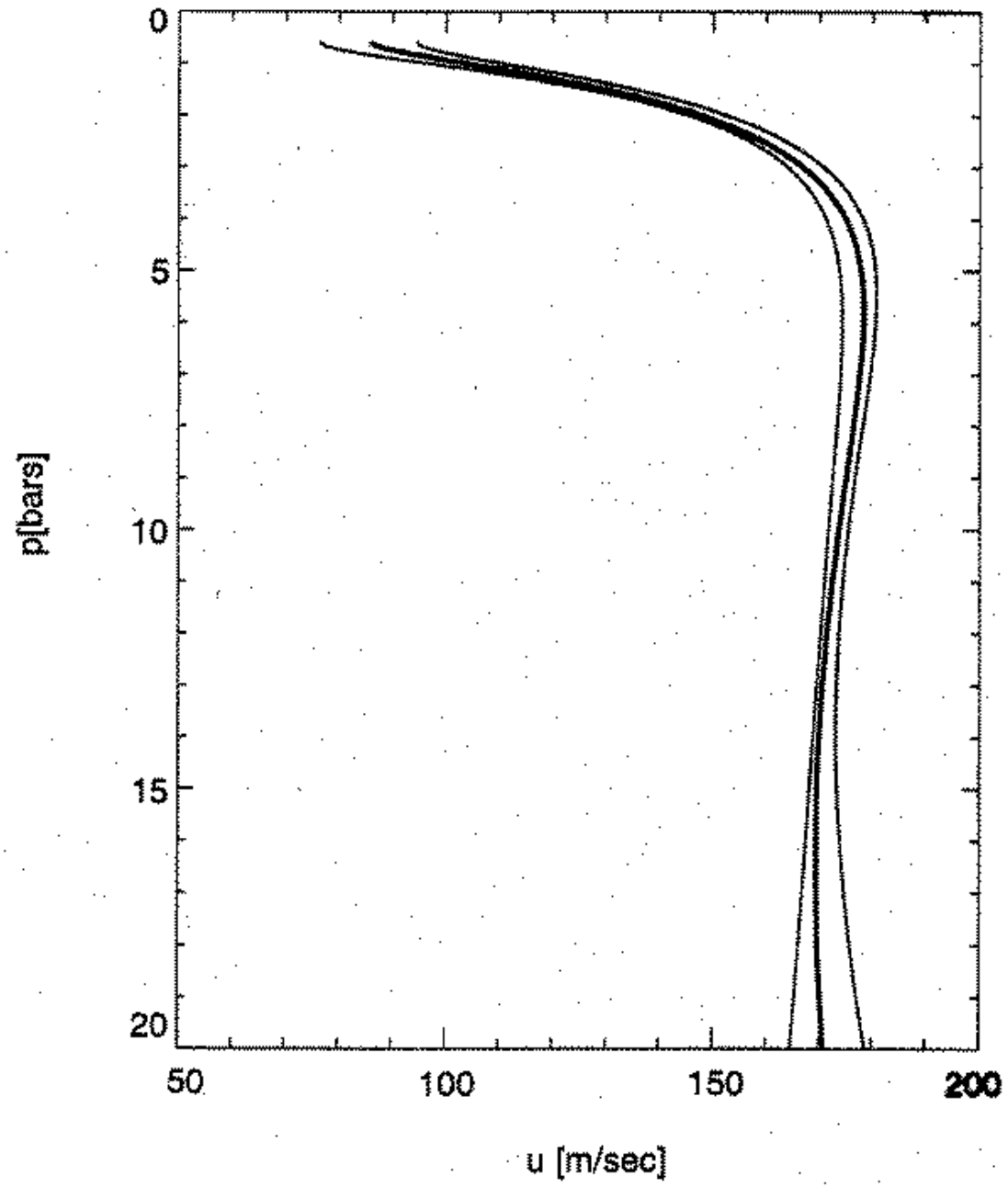
- Put probes in context of other missions
- SSE Decadal Survey - Key questions
- Measurement objectives for probes:
- Water, winds, temperature gradient


QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.



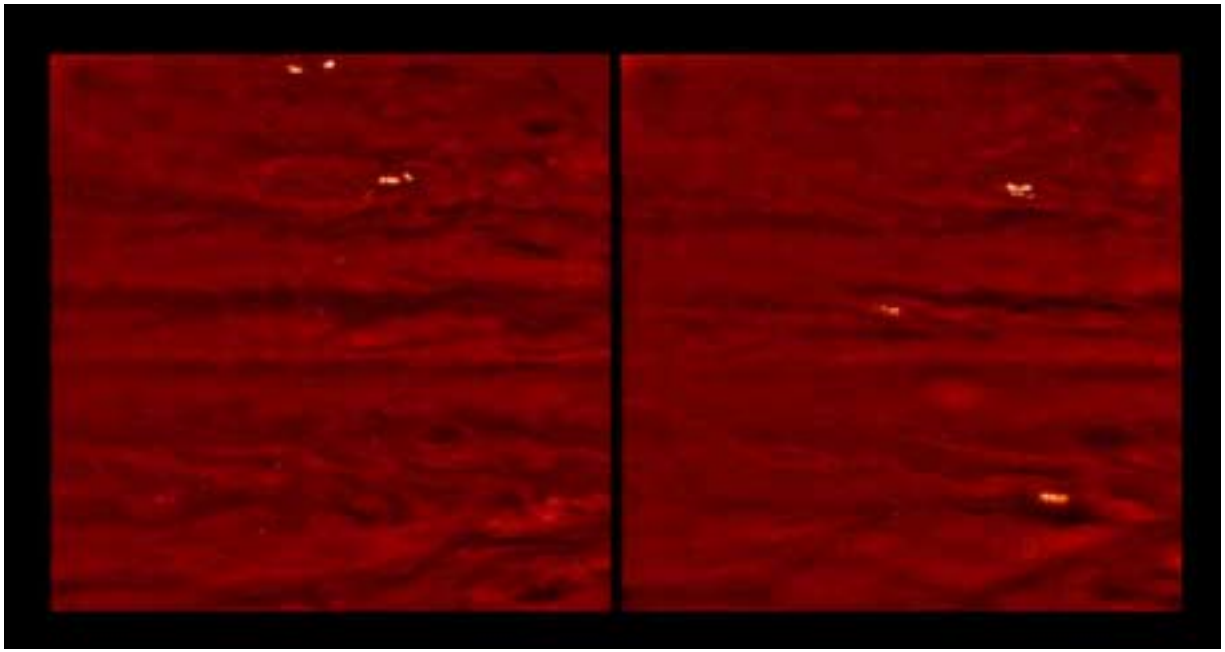

A
Galileo
solar
2 x solar
3 x solar
p [bars]
1
10
100
200
300
400
T_v [K]


Uranus
Neptune
Latitude
90°
60°
30°
0°
-30°
-60°
-90°
-200
0
200
-600
-400
-200
0
200
400
Eastward Wind Speed (m s-1)
Jupiter
Saturn
Latitude
-100
0
100
0
100
200
300
400
500
Eastward Wind Speed (m s-1)


0
5
10
15
20
p[bars]
50
100
150
200
u [m/sec]

Lightning in the Moonlight 0° to 50°N

Lightning is deep (≥ 5 bars). Thunderstorms mainly in the belts; they may power the larger structures. Water, deep winds, and dT/dz are critical



Solar System Mission Priorities:

- ***Small Class (<$325M)***
  1. **Discovery missions at one launch every 18 months**
  2. **Cassini Extended mission (CASx)**

- ***Medium Class (<$650M) – New Frontiers***
  1. **Kuiper Belt/Pluto (KBP)**
  2. **South Pole Aitken Basin Sample Return (SPA-SR)**
  3. **Jupiter Polar Orbiter with Probes (JPOP)**
  4. **Venus In-situ Explorer (VISE)**
  5. **Comet Surface Sample Return (CSSR)**

- ***Large Class (>$650M)***
  1. **Europa Geophysical Explorer (EGE)**

- **Jupiter Polar Orbiter with Probes (JPOP)**

A close-orbiting polar spacecraft equipped with various instruments and a relay for three probes that make measurements below the 100+bar level.

Key scientific questions (addresses 4 out of 12)

- **Over what period did the gas giants form, and how did the birth of the ice giants (Uranus, Neptune) differ from that of Jupiter and its gas-giant sibling, Saturn?**
- **What is the history of volatile compounds, especially water, across our solar system?**
- **How do the processes that shape the contemporary character of planetary bodies operate and interact?**
- **What does our solar system tell us about the development and evolution of extrasolar planetary systems, and *vice versa?***

Jupiter Polar Orbiter with Probes (JPOP)

GOALS:

- **Determine if Jupiter has a central core to constrain ideas of its formation**
- **Determine the planetary water abundance**
- **Determine if the winds persist into Jupiter's interior or are confined to the weather layer**
- **Assess the structure of Jupiter's magnetic field to learn how the internal dynamo works**
- **Measure the polar magnetosphere to understand its rotation and relation to the aurora**

Jupiter Probes

- Want 3 probes to 100 bars - substantial (5x) increase in depth over Galileo and 3x the number, maybe 2 probes if targeted right
- SEB or NEB, STrZ or NTrZ, GRS, polar regions
- Measure composition, winds, turbulence, T(z), clouds, solar and IR radiation - like Galileo probe
- Emphasize H_2O, NH_3, H_2S; maybe not other gases; maybe not lightning
- Microwave radiometer is complementary. It doesn't have to be simultaneous with probe